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THE RELATION OF THE SOUTHERN APPALACHIAN MOUNTAINS TO THE DEVELOPMENT OF WATER POWER.

By

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On March 4, 1907, Congress passed the following provision in connection with the Agricultural appropriation bill:

> *Survey of and report on Appalachian and White Mountain watersheds.*—To enable the Secretary of Agriculture to examine, survey, and ascertain the natural conditions of the watersheds at and near the sources of the various rivers having their sources in the Southern Appalachian Mountains and the White Mountains, and to report to Congress the area and natural conditions of said watersheds, the price at which the same can be purchased by the Government, and the advisability of the Government purchasing and setting apart the same as national forest reserves for the purpose of conserving and regulating the water supply and flow of said streams in the interest of agriculture, water power, and navigation. * * *

Because of its identification with studies of stream flow and its facilities for stream measurement, arrangement was made with the Geological Survey for a study of the water resources of the Southern Appalachian Mountains. The following report on The Relation of the Southern Appalachian Mountains to the Development of Water Power has resulted from that study.

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THE RELATION OF THE SOUTHERN APPALACHIAN MOUNTAINS TO THE DEVELOPMENT OF WATER POWER.

INTRODUCTION.

Water power is a prime factor in the present industrial development of the South. The abundance of water supply and the slope of rivers have recently brought to the region watered by streams from the Southern Appalachian Mountains the greatest development of water power that has ever taken place, during a similar period, anywhere in the United States. The resource represented by this water power is far greater than its present market value. Fuel must become more and more costly as the available supply is depleted. This means that the cost of fuel power, which is at present much greater than that of water power, will constantly increase, and the demand for water power will increase in proportion. A low average of the present rental value of water power is $20 per horsepower per year. This figure will be used in this report to estimate the present value of the power available for development in the Southern Appalachian region. The future value can not be estimated.

According to estimates made by the United States Geological Survey there is a minimum of about 2,800,000 indicated horsepower developed by the rivers having their headwaters in the Southern Appalachian Mountains. Mature consideration of the condition leads the Survey to estimate that at least 50 per cent and probably much more of this indicated power is available for economic development. It should be borne in mind that this figure represents merely the mimimum horsepower. If auxiliary power were provided to supply short seasons of water deficiency it would be profitable to develop up to 2½ times this amount. Full development of storage facilities would increase the minimum from 3 to 30 times. Obviously an estimate of present value based on 50 per cent of the minimum indicated horsepower is sure to be extremely conservative.

The rental of 1,400,000 horsepower at $20 per horsepower per year would amount to an annual return of $28,000,000. This amount is equal to a gross income of 3 per cent on a capital of about $933,000,000. Some of this power has already been developed, but a very small proportion—hardly enough to make any appreciable showing when the enormous resources of the region are taken into account.

The above estimates of power are based on present condition of the drainage areas. They represent what can be accomplished if the present forests of the mountains are protected from this time on.

Abuse of many of the important upland areas has already largely reduced the availability of the power which is present, and the further such abuse extends the less available the power will be.

The amount of power that can profitably be developed on any stream is governed by the length and severity of the low-water season—not by the height and violence of the floods. The more uniform the flow of a river, the more valuable it becomes for power as well as for all other purposes, and uniformity of flow is dependent chiefly upon the condition of the land surface. Rain which falls upon an asphalt-paved street drains away sooner than that which falls upon a country lane. The same principle holds for all land surfaces. An upland denuded of forests and with land surface hardened and baked by exposure discharges the rain water into the streams and rivers in great floods, and retains no water to supply the rivers in the dry season. In discharging in this torrential way, the water carries along the best part of the land itself, which, of course, is the fertile upper soil. Great furrows and gullies are cut across the fields, and the gravel and stones that are carried along are deposited in the lower country, and generally on the top of fertile bottom lands.

In the Southern Appalachians the fullest use of water resources can be secured only by carefully guarding the natural conditions which control them. The valuable water resources of this region depend absolutely upon the maintenance of a protective forest cover. Without this forest cover the water power of the region can never be developed to the full, and in the same way the navigable streams can not be kept from silting up if the forest cover about their headwaters is removed. The protection of these forests is a large undertaking, but it is necessarily the first undertaking, since it is fundamental to the development and utilization of the water resources. If the forest is not first protected damage to water resources will be far-reaching. If the forest is preserved the benefits from the standpoint of water utilization will be widely diffused, even far beyond the borders of the Appalachian region. It, therefore, is necessary that a forest system, similar to that which has accomplished so much toward conserving the forest and water resources of the West, be inaugurated in the Appalachian Mountains. Another urgent reason for protecting the forests on the Appalachian Mountains is the need of conserving the main center of hardwood supply of the United States and the industries which depend upon hardwoods. But the need of providing for the fullest development of water power is hardly secondary, and by itself would justify the extension to this region of the protection which is given through national forests in the West.

The following data are presented by the United States Geological Survey on the discharge of streams and the water storage facilities of the Southern Appalachian region, as related to the production of water power. The results are based on the data accumulated at the regular measurement stations maintained by the Survey during the past seven years, reenforced by special work carried on during the spring, summer, and fall of 1907. The schedules of water power are based on the minimum indicated horsepower developed in the rivers under consideration. In order to find this minimum horsepower the rivers were divided into sections of convenient length and of similar character, and the mean drainage area for each section was determined. The minimum flow per square mile for each section, based on seven-year records and auxiliary observations, was then calculated, and the indicated horsepower was deduced from the total slope of the channel. Additional estimates are given concerning the power which could be made available by storage. The location and capacity of reservoirs, together with other necessary facts, are shown in tabular form. Finally, there are given estimates of power based on lowest flow during the 6 highest months of the year. These estimates, as will be seen, are considerably higher than those based upon the minimum flow. They will serve to show what the commercially profitable development is likely to be. In this and other parts of the United States experience has shown that it pays to develop a water power up to the minimum that can be furnished during the 4 high-water months of the year, and to depend on steam power during low-water seasons to make up the deficiency. To make the present estimate conservative the limit of time has been extended to six months, and estimates are based upon that period.

Large allowances have been made in all the factors involved in the water power considerations. In all calculations of water power, only 90 per cent of the observed fall is used, and the indicated energy produced by the falling water is reduced to 80 per cent. It is believed that all the estimates can be used with safety, and in actual practice it will probably be found that in nearly every case the power available for development is considerably greater than that indicated.

Table 1 gives the names of rivers considered in this report and the minimum indicated horsepower developed in each.

TABLE 1.—*Rivers investigated.*

River.	Portion considered.	Minimum indicated horsepower
Potomac	Above tide, Washington, D. C	131,800
James	Above tide, Richmond, Va	155,000
Roanoke	Above tide, Weldon, N. C	131,000
Pedee	Above tide, Cheraw, N. C	171,300
Santee	Above junction of Wateree and Congaree	320,200
Savannah	Above Augusta, Ga	209,000
Chattahoochee	Above Columbus, Ga	145,000
Coosa	Above Wetumpka, Ala	180,000
Monongahela	Above mouth	58,900
Great Kanawha	do	335,000
Tennessee	Above Riverton, Ala	992,700
Total		2,829,900

The following paragraphs contain a discussion of the power possibilities on streams rising in the Southern Appalachian region.

RIVERS ON ATLANTIC SEABOARD.

POTOMAC RIVER.

The Potomac River basin is the northernmost of the coast basins which have their headwaters within the proposed Southern Appalachian National Forest. There are abundant sites for storage reservoirs in the upper drainage area, and to demonstrate the possibilities of increasing water power by such storage, certain sites have been selected and their capacities determined. This information will be used in connection with subsequent discussions. The facts are set forth in Table 2.

TABLE 2.—*Selected reservoir sites in the Potomac River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Square miles.*	*Feet.*	*Acres.*
North Fork, South Branch, Potomac River at Petersburg, W. Va.	460	1.12	520	18,550	460	134	7,600
North Fork, South Branch, Shenandoah River, Rockingham County, Va.	210	.84	180	6,910	210	92	3,410
North River, Rockingham County Va.	290	1.33	390	14,150	290	96	9,710
Middle River, Augusta County, Va.	180	1.33	240	6,190	140	100	4,250
South Fork, Shenandoah River, Rockingham County, Va.	500	1.42	710	2,290	50	40	3,930
South Fork, Shenandoah River, Rockingham County, Va.	200	1.42	280	10,420	200	95	7,150

The facts concerning the indicated horsepower along the main stream from tide water up to Harpers Ferry are set forth in Table 3.

TABLE 3.—*Indicated horsepower developed by Potomac River between tide water and Harpers Ferry.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Potomac River:	*Miles*	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From Mile 2 to Mile 5	3	11,500	2,070	4,830	31	5,840	13,600	4,600	9,200	18,400
From Mile 5 to below Great Falls	7	11,450	2,060	4,810	23	4,310	10,000	3,410	6,820	13,640
At Great Falls	2	11,400	2,050	4,790	76½	14,250	33,300	11,300	22,600	45,200
From above Great Falls to Mile 21	7	11,300	2,030	4,750	18	3,320	7,770	2,670	5,340	10,680
From Mile 21 to Mile 49	28	10,400	1,870	4,370	32	5,440	12,700	4,740	9,480	18,960
From Mile 49 to Harpers Ferry	12	9,480	1,700	4,170	40	6,180	15,200	5,930	11,860	23,720
Total						39,340	92,570	32,650	65,300	130,600

Between Harpers Ferry and the junction of North and South branches, a distance of 108 miles, the average slope is 2.5 feet per mile, and over much of the way it is so gradual that the installation of large power plants would involve the construction of long and expensive canals. Indeed, the Chesapeake and Ohio Canal is a good illustration of what would be necessary. The facts concerning the slope, flow, and indicated horsepower developed by this section of the river are given in Table 4.

TABLE 4.—*Indicated horsepower developed by Potomac River between Harpers Ferry and the junction of North and South branches.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Potomac River:										
From Harpers Ferry to Mile 63	*Miles.* 2	*Sq. miles.* 6,350	*Sec. ft.* 762	*Sec. ft.* 3,050	*Feet.* 36	2,490	9,980	1,700	3,400	6,800
From Mile 63 to Dam No. 4	22	6,120	734	2,940	23	1,540	6,150	1,090	2,180	4,360
From Dam No. 4 to Dam No. 5	20½	5,420	650	2,600	32	1,890	7,560	1,510	3,020	6,040
From Dam No. 5 to Sir Johns Run	24½	4,520	543	2,170	45	2,220	8,860	2,130	4,260	8,520
From Sir Johns Run to Dam No. 6	5	4,070	489	1,960	24	1,070	4,280	1,140	2,280	4,560
From Dam No. 6 to Haurote	14	3,630	436	1,740	34	1,350	5,370	1,610	3,220	6,440
From Haurote to Pawpaw	13	3,190	383	1,530	32	1,110	4,450	1,510	3,020	6,040
From Pawpaw to below mouth of South Branch of Potomac	7½	3,010	361	1,450	20	656	2,640	945	1,890	3,780
Total						12,326	49,290	11,635	23,270	46,540

North Branch.—The North Branch is about 80 miles long, and has a total fall of about 2,570 feet, 1,000 feet of which occurs within 12 miles from the source. There is a minimum of 4,700 indicated horsepower developed by the main stream, and 1,870 by the tributaries. The greater part of this, however, could not be developed profitably at the present market price of power. The portion of the river best adapted for power is that between Abrams Creek and Cumberland. Along a distance of 44 miles there is a total fall of 1,060 feet. The average minimum discharge is 37 cubic feet per second, which will produce a minimum indicated horsepower of 3,170. The minimum developed during the 6 high-water months along this portion of the stream is 18,920 horsepower. In a distance of 7 miles below Cumberland there is a fall of 63 feet, which could be developed for a minimum of 480 horsepower, or, based on the 6 highest months, for 2,900 horsepower.

South Branch.—Various portions of this river are well adapted for the development of power. The minimum on the main stream and its tributaries is 15,207 indicated horsepower, while the minimum for the 6 highest months is 52,685 horsepower; only a small part of this could be profitably developed at the present rental price. The details concerning the main stream are given in Table 5:

TABLE 5.—*Indicated horsepower developed by South Branch of Potomac River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
South Branch, Potomac River:										
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to Romney.......	29.6	1,450	189	653	114	1,960	6,770	5,400	10,800	21,600
From Romney to below junction Moorefield River..........	24	1,300	169	585	136	2,090	7,230	6,430	12,860	25,720
From above junction Moorefield River to below junction North Fork, South Branch, Potomac River	16½	770	100	347	155	1,410	4,890	4,250	8,500	17,000
From above junction North Fork South Branch Potomac River, to below junction Thorn Run...........	35	236	31	107	730	2,040	7,100	None.	None.	None.
From above junction Thorn Run to source.........	25	[a] 123	13	46	[b] 425	520	1,780	None.	None.	None.
Total........	......	....	....	....	......	8,020	27,770	16,080	32,160	64,320

[a] Total area.

[b] 25 per cent total fall.

Shenandoah River.—Along the main stream of the Shenandoah there is a minimum of 31,970 indicated horsepower available for development. The minimum for the 6 highest months is 63,540 horsepower.

Among the other tributaries of the Potomac on which considerable horsepower is available are the following:

South River, a tributary of the South Fork of the Shenandoah, is 50 miles long, and has a fall of 1,950 feet. In the lower 22 miles there is a fall of 250 feet, with a minimum indicated horsepower of 1,020. The minimum for the 6 highest months is 1,940 horsepower. South Fork of the Shenandoah is 101 miles long, and has a total fall of 576 feet. There is developed a minimum indicated horsepower of 17,690, while the minimum for the 6 highest months of the year is 34,390 horsepower. In the first 17 miles above the mouth of the river there is a total fall of 70 feet, with a minimum horsepower of 2,640. The minimum for the 6 highest months is equivalent to 5,170 horsepower. In the next 20 miles there is a total fall of 114 feet and a minimum indicated horsepower of 3,940, while the minimum for the next 15 miles is 2,330 horsepower. Above this there is a section 9 miles long with a fall of 63 feet and a minimum of 1,860 indicated horsepower. On the North Fork of the Shenandoah the conditions are similar to those on the South Fork. The portion of the stream best adapted to power development is the lower section of 48 miles. This section has a fall of 390 feet and a minimum flow of 152 cubic feet per second, the energy of which is represented by 4,860 horsepower. The minimum for the 6 highest months is 9,720 horsepower.

Along the main stream of the Shenandoah there are several good power sites. The facts concerning this portion of the river appear in Table 6.

TABLE 6.—*Indicated horsepower developed by Shenandoah River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Shenandoah River:										
	Miles.	*Sq. miles.*	*Sec.ft.*	*Sec.ft.*	*Feet.*					
From mouth (Harpers Ferry) to Cattail Run	6	3,010	720	1,540	41	2,680	5,740	4,140	8,280	16,560
From Cattail Run to Mile 7	2	3,000	720	1,530	32	2,090	4,450	3,230	6,460	12,920
From Mile 7 to Mile 27½	20½	2,900	700	1,480	44	2,800	5,920	4,440	8,880	17,760
From Mile 27½ to Mile 39½	12	2,750	690	1,380	30	1,880	3,760	3,030	6,060	12,120
From Mile 39½ to Wilson's Mill	9½	2,670	670	1,310	31	1,890	3,690	3,130	6,260	12,520
Total						11,340	23,560	17,970	35,940	71,880

There are, of course, many sites on smaller tributaries at which powers could profitably be developed. The nature of this paper does not allow of their further mention here, but information concerning them can be obtained by addressing the United States Geological Survey.

JAMES RIVER.

The basin of the Potomac adjoins the James River basin. The drainage area of the James River above Richmond, Va., is 6,790 square miles in extent, and its length from tide to source at the head of Jackson River is 315 miles. Its minimum flow varies from 0.19 to 0.41 cubic foot per second per square mile. Among the many reservoir sites in the drainage area, those shown in Table 7 have been selected as the best combination.

TABLE 7.—*Selected reservoir sites in the James River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Sq. mi.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Sq. mi.*	*Feet.*	*Acres.*
Jackson River, west Bath County, Va.	300	1.18	350	12,400	300	124	5,100
Cowpasture River, Bath County, Va.	280	1.18	330	10,700	280	118	4,300
North River, Rockbridge County, Va.	210	1.18	250	8,620	210	137	5,440
Calfpasture River, southwest Augusta County, Va.	120	1.18	140	4,140	110	100	2,850
James River, Botetourt County, Va.	1,060	1.18	1,250	43,890	1,060	135	18,470
Buffalo Creek, Rockbridge County, Va.	80	1.18	90	3,660	80	113	1,980
Johns Creek, Newcastle, Va.	90	1.18	110	4,620	90	123	3,120

The main stream between Richmond and Eagle Mountain, a distance of about 215 miles, has a rapid fall and many promising sections for power development.

Jackson River, which is the upper extension of the James, is 83 miles long. Between its source and the head of the James there is a fall of 2,150 feet. Along the first 14-mile section above Clifton Forge there is a fall of 170 feet. The mean catchment drainage area is 816 square miles, with a minimum discharge of 204 cubic feet per second. There is a minimum horsepower of 2,840. The lowest flow for the 6 high-water months develops 5,450 horsepower. Above this section between Dunlap and Potts Creek there is a fall of 30 feet in a distance of 4 miles, equivalent to a minimum horsepower of 392, or a minimum for the 6 highest months of 770. The increase from storage during six months would be 1,720 horsepower. A statement of the prevailing conditions is given in Table 8.

Table 8.—*Indicated horsepower developed by James River between Richmond and Eagle Mountain and by Jackson River between Clifton Forge and Back Creek.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
James River:										
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From Richmond to Lorraine	14	6,770	2,780	3,660	112	28,300	37,300	25,600	51,200	102,400
From Lorraine to Irwin	21.5	6,610	2,710	3,570	25	6,160	8,110	5,720	11,400	22,800
From Irwin to Columbia	23.5	6,160	2,530	3,330	34	7,820	10,300	7,780	15,600	31,200
From Columbia to Payne	18	5,200	1,720	2,550	63	9,850	14,600	14,400	28,800	37,600
From Payne to Howardsville	16	4,500	1,260	2,030	38	4,360	7,000	8,700	17,400	34,800
From Howardsville to Warminster	9	4,320	1,170	1,900	27	2,870	4,660	6,180	12,400	24,800
From Warminster to Greenway	14	3,940	950	1,660	40.5	3,500	6,110	9,280	18,600	37,200
From Greenway to Riverville	9	3,650	800	1,500	34	2,470	4,640	7,780	15,600	31,200
From Riverville to Joshua Falls Dam	12.5	3,550	780	1,420	42	2,980	5,420	9,620	19,200	38,500
From Joshua Falls Dam to Lynchburg	11.5	3,440	722	1,380	45	2,960	5,650	10,300	20,600	41,200
From Lynchburg to Big Island	18	3,230	646	1,290	85	5,000	10,000	19,500	39,000	78,000
From Big Island to Balcony Falls	9	3,060	612	1,190	86	4,790	9,310	19,700	39,500	79,000
From Balcony Falls to Varney Falls	10	2,180	414	828	48	1,800	3,610	8,900	17,800	35,600
From Varney Falls to Buchanan	11	2,100	400	798	58	2,110	4,210	10,750	21,500	43,000
From Buchanan to Saltpeter Cave	10	2,010	382	765	62	2,150	4,310	11,500	23,000	46,000
From Saltpeter Cave to Eagle Mountain	8	1,890	360	737	41	1,340	2,750	2,040	4,080	8,160
Jackson River:										
From above Clifton Forge to below junction Potts Creek	14	816	204	392	153	2,840	5,450	4,000	8,000	16,000
From above junction Potts Creek to below junction Dunlap Creek	4	613	160	313	27	392	770	860	1,720	3,440
From above junction Dunlap Creek to below junction Back Creek	27	367	99	198	428	3,850	7,700	13,600	27,250	54,500
Total	......	....	....	....	......	95,542	151,900	196,210	392,650	765,400

Tributaries.—The tributaries of James River have steep courses; the drainage areas are comparatively large, and the summer flow is considerable. North River, the largest tributary, has a total drainage area of 831 square miles. The section from Rockbridge bar to the mouth, 34 miles long, has a total fall of 390 feet and a minimum run-off of 140 cubic feet per second, which will develop 4,470 minimum horsepower. Many places along this stream would be suitable for small installations. Riviana River, another tributary, has a drainage area of 774 square miles. In the 51 miles between the mouth of Moormans River and the James, there is a fall of 210 feet, and the minimum run-off is estimated at 331 cubic feet per second. If 189 feet of this fall were developed there would be a minimum of 5.680 horsepower.

ROANOKE RIVER.

On the south the basin of the Roanoke adjoins that of the James. Consideration of available power is confined to that part of the river above Weldon, N. C., which is the head of important navigation. Above this point the river has a drainage area of 8.620 square miles. Its length, by way of South Fork, to the head of Bottom Creek, is 272 miles, and the amount of water carried in the channel is equivalent to from 0.25 to 0.47 cubic foot per second per square mile; that is, each square mile of drainage area contributes a minimum flow of that amount of water. There are excellent storage facilities in the basin; if these are properly developed it will be possible to control the flow of the river to an unusual degree and to increase its value enormously. The reservoir sites shown in Table 9 have been selected as representing an excellent combination for such purposes.

TABLE 9.—*Selected reservoir sites in the Roanoke River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Sq. miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Sq. miles.*	*Feet.*	*Acres.*
North Fork, Roanoke River, east Montgomery County, Va.	120	1.23	150	4.820	120	125	2.170
South Fork, Roanoke River, southeast Montgomery County, Va.	110	1.23	140	4.600	110	140	1.790
Goose Creek, Bedford County, Va.	260	1.23	320	10.200	260	106	6.560
Roanoke River, Bedford County, Va.	760	1.23	930	29.700	760	150	15,000

The main stem of the Roanoke, from Weldon, N. C., to the junction of North and South forks, is 249 miles long, and has a total fall of 1,225 feet. The average slope is, therefore, 5 feet per mile. The fall is not uniform, however, and there are many precipitous slopes which afford favorable sites for power development. The indicated horsepower along the river, as shown in chosen sections, is set forth in Table 10.

Table 10.—*Indicated horsepower developed by Roanoke River between Weldon, N. C., and junction of North and South forks.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	 6 months.	 3 months.
Roanoke River:										
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From Weldon (Mile 0) to Mile 6	6	8,600	3,960	6,450	50	18,000	29,300	7,000	14,000	28,000
From Mile 6 to Mile 12	6	8,580	3,950	6,440	34	12,200	19,900	4,750	9,500	19,000
From Mile 12 to Mile 29	17	8,500	3,910	6,380	49	17,400	28,400	6,850	13,700	27,400
From Mile 29 to Mile 46	17	8,250	3,790	6,190	22.5	7,750	12,700	3,150	6,300	12,600
From Mile 46 to Mile 58	12	7,970	3,670	5,980	23.5	7,840	12,800	3,290	6,580	13,200
From Mile 58 to Clarksville	12	7,600	3,500	5,700	47	14,950	24,400	6,600	13,200	26,300
From Clarksville to Mile 104.5	34.5	3,300	1,550	2,440	55	7,750	12,200	7,700	15,400	30,800
From Mile 104.5 to Scotts Ferry	22	2,750	1,240	1,950	35	3,950	6,200	4,900	9,800	19,600
From Scotts Ferry to Mile 132	5.5	2,430	1,020	1,630	37	3,430	5,480	5,200	10,400	20,700
From Mile 132 to Clements Falls	25.5	2,080	770	1,310	97	6,790	11,600	13,600	27,200	54,300
From Clements Falls to below junction Pig River	22.5	1,590	508	920	64	2,950	5,350	7,800	15,600	31,100
From below junction Pig River to Smith Mountain Gap	4.3	1,219	342	659	15.3	476	916	1,695	3,390	6,780
From Smith Mountain Gap to Turners Ford	20.7	849	221	416	90	1,810	3,400	Obliterated by proposed reservoir.		
From Turners Ford to Mile 219	14	632	158	291	69	990	1,820	920	1,840	3,690
From Mile 219 to below junction Tinker Creek	7	546	137	246	95	1,180	2,130	2,500	5,000	10,000
From below junction Tinker Creek to 1 mile above Salem	12.5	410	102	193	110	1,020	1,930	2,900	5,800	11,600
From 1 mile above Salem to junction North Fork of Roanoke River	11	283	74	136	207	1,390	2,560	5,450	10,900	21,800
Total						109,876	181,086	84,305	168,610	336,870

Tributaries.—The principal tributary of the Roanoke, the Dan River, is not included in these estimates, because its drainage area lies almost entirely below the Southern Appalachian region proper. The principal value of the rest of the tributaries of the Roanoke lies in the fact that they are contributors to the main stream. They do not afford many power sites, although there are some good ones of limited capacity. Otter River, between Little Otter River and the mouth, is 18 miles long and has a total fall of 90 feet. The minimum indicated horsepower is 1,430, and that for the 6 high-water months 2,150. Goose Creek below the junction of Wolf Creek is 21 miles long and has a fall of 125 feet, which would develop 985 horsepower for a minimum, or 1,380 horsepower for the 6 high-water months. The lower 23 miles of Blackwater River has a fall of 230 feet, which if all developed would produce 1,260 horsepower, or a minimum for the 6 high-water months of 2,520 horsepower. The development of all of these tributaries would, however, be quite expensive.

PEDEE RIVER (YADKIN).

That part of the Pedee system here considered for power development lies entirely above Cheraw, S. C., which is the head of extensive navigation. The total length above Cheraw is 253 miles. The name Pedee is given to the river up to the mouth of the Uharie River. Above this point the river is called the Yadkin.

Among the many reservoir sites in the Yadkin basin those shown in Table 11 have been selected as the most effective combination:

TABLE 11.—*Selected reservoir sites in the Yadkin River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Square miles.*	*Feet.*	*Acres.*
Yadkin River, Wilkesboro, N. C.	500	2.72	1,360	42,050	480	130	22,600
Yadkin River at Elkville, N. C.	230	2.72	620	20,300	230	140	10,100
South Yadkin River, Davie County, N. C.	730	2.72	2,000	20,500	230	80	15,600
Deep Creek, Yadkinville, N. C.	120	2.72	330	9,400	110	100	6,600
Ararat River, Surrey County, N. C.	290	2.72	790	5,300	60	100	3,700

The distance from Cheraw, S. C., to the mouth of Uharie River is 73 miles. The first 60 miles, from Cheraw to Allentown Ferry, has a fall of 136 feet and an average minimum discharge of 2,320 cubic feet per second. This will produce a minimum indicated horsepower of 25,800. There are numerous shoals along this section, and a large proportion of the indicated power could actually be developed. This is also true of the next section of 13 miles between Allentown Ferry and Uharie River. The fall is 38 feet, the minimum flow 2,300 cubic feet per second, and the indicated minimum horsepower 7,160. The minimum for the 6 highest months on the lower section is 38,800, and that for the upper section 10,700 indicated horsepower. The increase from storage would be as follows:

Lower section—37,400 horsepower for one year, 74,800 horsepower for six months, and 149,600 horsepower for three months.

Upper section—10,400 horsepower for one year, 20,800 horsepower for six months, and 41,600 horsepower for three months.

The indicated horsepower along designated sections of the Yadkin, from the mouth of Uharie River to Buffalo Creek, is given in Table 12.

TABLE 12.—*Indicated horsepower developed by Yadkin River between the mouth of Uharie River and Buffalo Creek.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Yadkin River:										
	Miles	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From Uharie River to Salisbury	47	3,650	2,010	3,020	380	69,400	104,000	116,000	232,000	464,000
From Salisbury to South Yadkin River	4	3,400	1,980	2,970	5	972	1,460	1,650	3,300	6,600
From South Yadkin River to Ararat River	45	2,000	1,400	2,100	117	14,800	22,300	26,400	52,800	105,600
From Ararat River to Roaring River	33	970	776	1,160	146	10,300	15,400	26,200	52,400	104,800
From North Wilkesboro to Buffalo Creek	25	240	264	396	212	5,080	7,610	5,640	11,280	22,560
Total						100,552	150,770	175,890	351,780	703,560

Tributaries.—The drainage areas of the tributaries of Yadkin River are generally too limited to be important for power development, although the total energy produced in them is considerable. South Yadkin River, for example, has a length of 51 miles. There is a total fall of 618 feet and a minimum discharge of 262 cubic feet per second, giving an indicated minimum horsepower of 4,240. Ararat River, 35 miles long, has a fall of 700 feet. Considering a mean head of 207 feet and a minimum discharge of 230 cubic feet per second, there is an indicated horsepower of 4,330. A large part of the power on both streams would be obliterated by the construction of the proposed South Yadkin and Ararat reservoirs. Conditions on the rest of the important tributaries of the Yadkin are similar. They are summed up in Table 13:

Table 13.—*Indicated horsepower developed by tributaries of Yadkin River (except South Yadkin and Ararat rivers.)*

Section of river.	Length.	Total drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*						
Fisher River, from mouth to head	32	151	107	160	270	2,630	3,940	None.	None.	None.
Mitchell River, from mouth to head	20	108	92	138	290	2,420	3,630	None.	None.	None.
Roaring River, from mouth to head	17	130	107	160	260	2,530	3,800	None.	Power slightly reduced by Wilksboro Res.	
Mulberry River, from mouth to head	16	42	42	63	270	1,030	1,540	None.	Power slightly reduced by Wilksboro Res.	
Reddie River, from mouth to head	20	92	107	160	345	3,360	5,040	None.	Power slightly reduced by Wilksboro Res.	
Louis Fork, from mouth to head	13	73	70	105	425	2,700	4,050	None.	None.	None.
Stony Creek, from mouth to head	12	35	42	63	500	1,910	2,860	None.	Power slightly reduced by Elksville Res.	
Elk River, from mouth to head	16	51	61	92	370	2,050	3,080	None.	Power slightly reduced by Elksville Res.	
Total						18,630	27,940			

Santee River.

The Wateree and the Congaree rivers join to form the Santee 180 miles above its mouth. The Santee proper is a navigable stream, with comparatively little fall, so that power is considered only for the area above the fork. On the Wateree the section between the mouth and Camden will not be considered.

CATAWBA RIVER.

Table 14 gives detailed facts concerning the storage facilities at the headwaters of Catawba River, which is the name given to the Wateree above the mouth of Wateree Creek.

Table 14.—*Selected reservoir sites in the Catawba River Basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Sq. mi.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Sq. mi.*	*Feet.*	*Acres.*
Catawba River, northwest Mecklenburg County, N. C	430	1.64	700	24,970	430	77	18,250
Catawba River, near Hickory, Catawba County, N. C	600	1.64	980	9,870	190	100	7,670
Catawba River, west of Morganton, N. C	480	1.64	790	5,380	100	75	4,920

The indicated horsepower developed by the Wateree and its tributaries is as follows:

The section from Camden to the mouth of Wateree Creek, 17 miles, has a total fall of 75 feet. The mean drainage area is 4,200 square miles, and the minimum flow 2,180 cubic feet per second. This will develop a minimum indicated horsepower of 13,400, or a minimum for the 6 highest months of 20,200. The storage indicated in the above table will increase the indicated horsepower for the section as follows: 8,050 for one year, 16,100 for six months, and 32,200 for three months. The greater part of this fall is concentrated in the 6½ miles beginning with the foot of Hoke Shoals. The available fall here is about 65 feet. This would produce a minimum of 11,600 horsepower, or a minimum for the 6 high-water months of 17,300. The increase by storage would amount to about 7,000 horsepower if evenly distributed over a period of twelve months.

The indicated horsepower produced by the main stem of the Catawba from the mouth of Wateree Creek to the mouth of North Fork, together with facts relating thereto, is shown in Table 15.

TABLE 15.—*Indicated horsepower developed by Catawba River between the mouth of Wateree Creek and the mouth of North Fork.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Catawba River:										
	Miles	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From Wateree Creek to Catawba, S. C.	29	3,650	2,010	3,020	252	46,100	69,100	30,000	60,000	120,000
From Catawba, S. C., to Little Catawba River.	28	3,100	1,860	2,790	36	6,080	9,090	4,300	8,600	17,200
From Little Catawba River to Catawba, N. C.	60	1,870	1,220	1,830	207	22,900	34,400	13,550	27,100	54,200
From Catawba, N. C., to John River	46	1,270	889	1,340	207	16,700	25,100	3,500	7,000	14,000
From John River to Linnville River	77	780	585	878	68	3,590	5,380	Greatly reduced by proposed Hickory Reservoir.		
From Linnville River to North Fork	17	460	345	518	117	3,670	5,510	Obliterated by proposed Morganton Reservoir.		
Total						99,040	148,580	51,350	102,700	205,400

It should be noted in connection with Table 15 that in all sections above Little Catawba the indicated power will be obliterated or modified by the construction of the reservoirs described in Table 14. For example, in the section between Little Catawba River and John

River a part of the river bed would be largely covered by the proposed reservoirs. This would, of course, obliterate the natural slope of the river at some sections, so far, at least, as it may be available for power development, and would concentrate the fall at the dam sites. The statements of increase of power from storage in the river above the mouth of Little Catawba have been adjusted to meet these changes in available fall.

CONGAREE RIVER.

Congaree River, which, as has been explained, unites with the Wateree to form the Santee, is in turn formed at Columbia, S. C., a few miles above its mouth, by the junction of the Broad and Saluda rivers. No report can be made at the present time concerning the storage facilities for these areas, owing to the want of surveys. For this reason the additional power which might be derived from storage will not be considered in discussing the water power in the Congaree basin.

BROAD RIVER.

From the junction of the Broad and Saluda rivers, down the Congaree 2 miles, there is a fall of 7 feet which might be somewhat increased by the construction of a diversion dam 10 or 12 feet high. Considering only the natural fall, there is derived from the 7,300 square miles of drainage area and the minimum flow of 3,650 cubic feet per second a minimum indicated horsepower of 2,090, which could be greatly increased by the development of storage facilities on the drainage area above.

The minimum indicated horsepower developed along the Congaree and Broad rivers, together with related facts, is set forth in Table 16.

TABLE 16.—*Indicated horsepower developed by Congaree and Broad rivers.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 months.
	Miles	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
Congaree River from Granky to Broad (Saluda) River	2	7,300	3,650	5,480	6	2,090	3,130	Not ascertained.		
Broad River:										
From mouth to Alston	25	4,800	2,640	3,960	81	19,400	29,200	Not ascertained.		
From Alston to Gaffney	80	3,000	1,800	2,700	288	47,200	70,700	Not ascertained.		
From Gaffney to Green River	36	1,000	700	1,050	196	12,500	18,700	Not ascertained.		
From Green River to Cove Creek	18	230	184	276	36	602	900	Not ascertained.		
From Cove Creek to head	24	[a] 106	106	159	[b] 740	7,130	10,700	Not ascertained.		
Total	......	....	....	....	......	88,922	133,330	....	....	....

[a] Total area.

[b] Mean head.

Tributaries of Broad River.—Many excellent sites for power development may be found on the tributaries of Broad River. From the head to the mouth of First Broad River, for example, a distance of 35 miles, there is a total fall of 900 feet, of which it is estimated that 320 feet is a fair amount to use for calculation of available power. The drainage area at the mouth is 275 square miles, and the minimum discharge 275 cubic feet per second, which will develop an indicated horsepower of 8,000. On the Second Broad River, in the 17 miles from the mouth to Logans Store, there is a fall of about 240 feet, which will develop an indicated horsepower of 2,940.

SALUDA RIVER.

Facts concerning the indicated horsepower on the Saluda River and its principal tributaries are set forth in Table 17.

TABLE 17.—*Indicated horsepower developed by Saluda River and principal tributaries.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Saluda River:										
From mouth to Southern Railway, Chappells.	*Miles.* 60	*Sq. miles.* 1,900	*Sec. ft.* 1,040	*Sec. ft.* 1,560	222	21,100	31,600	Not ascertained.		
From Southern Railway, Chappells, to Southern Railway, Piedmont.	65	900	585	878	329	17,600	18,200	Not ascertained.		
From Southern Railway, Piedmont, to Southern Railway, Greenville	10	350	245	368	54	1,210	1,810	Not ascertained.		
From Southern Railway, Greenville, to North Saluda River	10	270	202	303	81	1,480	2,230	Not ascertained.		
From North Saluda River to South Saluda River	5	160	144	216	36	472	707	Not ascertained.		
North Saluda River, from mouth to head	22	[a] 77	77	116	[b] 263	1,840	2,760	Not ascertained.		
Middle Saluda River, from mouth to head	15	[a] 50	50	75	[b] 400	1,820	2,730	Not ascertained.		
South Saluda River, from mouth to head	20	[a] 100	100	150	[b] 250	2,270	3,400	Not ascertained.		
Total						47,792	63,437			

[a] Total area. [b] Mean head.

SAVANNAH RIVER.

Savannah River is formed by the junction of the Seneca and Tugaloo rivers at Andersonville, S. C., 245 miles above the mouth, or 100 miles above Augusta, Ga. Tugaloo River is, in turn, formed by the junction of the Tallulah and the Chattooga, 48 miles above the junction of the Tugaloo and Seneca. In this paper the discussion of water power on the Savannah River is confined to the part of the drainage area lying above Augusta. The drainage area of Savannah River above this point is 7,300 square miles. The headwaters are well suited to the development of storage reservoirs, and from those parts of the basin upon which surveys have been made there have been selected a number of reservoir sites, the characteristics of which are set forth in Table 18.

TABLE 18.—*Selected reservoir sites in the Savannah River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Square miles.*	*Feet.*	*Acres.*
Keowee River, Pickens County, S. C	270	3.45	930	25,130	230	150	11,240
Little River, Oconee County, S. C	90	3.45	310	8,480	80	100	5,820
Twelve-Mile Creek, Pickens County, S. C	160	3.45	550	2,210	20	50	3,030
Twenty-three Mile Creek, Anderson County, S. C	150	3.45	520	15,370	140	70	6,620
Conneross Creek, Oconee County, S. C	80	3.45	280	1,700	20	50	2,330
Tugaloo River, southwest Oconee County, S. C	260	3.45	900	11,870	110	100	8,140
Chattooga River, west Oconee County, S. C	120	3.45	410	9,470	90	150	3,310
Chattooga River, west Oconee County, S. C	190	3.45	660	15,920	140	150	4,690
Tallulah River, Rabun County, Ga	130	4.35	570	2,440	20	90	1,860
South Fork River, Oglethorpe County, Ga	260	1.89	490	1,940	30	50	2,660
Broad River, Madison County, Ga.	440	1.89	830	28,590	440	98	17,850
Hudson River, Banks County, Ga.	180	1.89	340	4,680	80	50	6,420
Beaver Dam Creek, east of Elberton, Ga	110	1.89	210	7,030	110	98	3,960
Rocky River, near Lowndesville, S. C	240	1.89	450	9,680	160	100	6,580

That part of the Savannah River lying between Augusta, Ga., and the mouth of Seneca River, 100 miles long, has been divided into 5 sections for the purpose of considering indicated power as shown in Table 19.

TABLE 19.—*Indicated horsepower developed by Savannah River between Augusta, Ga., and Seneca River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Savannah River:										
From Augusta, Ga., to head of dam	*Miles* 7	*Sq. miles.* 7,000	*Sec. ft.* 4,200	*Sec. ft.* 6,300	*Feet.* 40	15,500	23,200	18,200	36,400	72,800
From head of dam to Little River, S. C	30	5,800	3,770	5,660	95	32,700	49,000	43,000	86,000	172,000
From Little River, S. C., to Broad River	16	4,700	3,290	4,940	21	6,190	9,270	9,300	18,600	37,200
From Broad River to Seaboard Air Line bridge	12	2,800	2,240	3,360	81	16,500	24,700	28,000	56,000	112,000
From Seaboard Air Line bridge to Seneca River	35	2,220	2,000	3,000	121	22,000	32,900	35,500	71,000	142,000
Total						92,890	139,070	134,000	268,000	536,000

TUGALOO RIVER.

In Tugaloo River, there is a section between the mouth of the river and Madison, 33 miles in length, along which there is a fall of 135 feet. The mean drainage area is 790 square miles, and the minimum flow 790 cubic feet per second, which would produce a minimum indicated horsepower of 8,730, or a minimum for the 6 highest months of 13,100. This would be increased by storage to 14,000 horsepower if distributed evenly over one year, or to 28,000 if utilized during a low-water season of six months. The next section, between Madison, S. C., and the mouth of Tallulah River, is 15 miles long, with a total fall of 114 feet. The mean drainage area is 530 square miles, which produces a minimum run-off of 689 cubic feet per second. This will afford a minimum indicated horsepower of 6,430, or a minimum for the 6 highest months of 9,630. The increase from storage facilities would be 8,240 if distributed over twelve months, or 16,480 for a six months' period. The greatest fall is in the upper portion of this section. In the 8 miles from the junction of Tallulah and Chattooga rivers down to Big John Creek there is a total fall of 104 feet.

CHATTOOGA RIVER.

Chattooga River is 39 miles long from its confluence with the Tallulah to the head of West Fork. The indicated horsepower developed and the facts relating thereto are shown in Table 20.

TABLE 20.—*Indicated horsepower developed by Chattooga River between its confluence with the Tallulah and West Fork.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Chattooga River:										
From Tallulah River to Stekoa Creek......	*Miles* 7	*Sq. miles.* 265	*Sec. ft.* 400	*Sec. ft.* 600	*Feet.* 266	9,630	14,400	Submerged.		
From Stekoa Creek to Clayton Station....	3	210	315	472	105	3,020	4,520	5,320	10,640	21,280
From Clayton Station to Warwoman Creek...........	13	189	285	428	[a]288	7,460	11,200	1,500	3,000	6,000
From Warwoman Creek to West Fork....	8	125	188	282	69	1,190	1,780	Submerged.		
Total........	......	....	....	....	......	21,300	31,900	6,820	13,640	27,280

[a] Fall reduced to about 33 feet by proposed reservoirs.

As Table 20 shows, the course of Chattooga River is steep, and it is probable that in the actual economical development of the power available all the fall could be utilized. In other words, the indicated horsepower represents the actual minimum available.

Tributaries of Chattooga River.—North Fork, from its mouth to its head, is 8 miles long and has a total fall of 1,000 feet. Considering 440 feet of this fall as available for development there would be produced 3,360 minimum horsepower. West Fork also is 8 miles long from its mouth to its head. There is a mean head of 300 feet, which, with a discharge of 93 cubic feet per second, would produce a minimum of 2,540 horsepower. Several good opportunities for small power installation are afforded by Toccoa and Brasstown creeks and Chauga River, tributaries of Tugaloo River. Stekoa Creek from its junction with Chattooga River to its head, a distance of 9 miles, has a total fall of 900 feet and a mean head of 500 feet, which will produce an indicated minimum horsepower of 2,640, or a minimum for the 6 highest months of 3,960.

Warwoman Creek, a tributary of Chattooga River, is 7 miles long, and has a total fall of 600 feet, and a mean head of 305, which will produce a minimum horsepower of 1,750, with a minimum for the 6 highest months of 2,620.

TALLULAH RIVER.

Tallulah River from head to mouth is about 44 miles long. Along the lower 35 miles there is a total fall of 716 feet, of which probably 90 per cent could be utilized. In other words, the indicated horsepower for this 35 miles is the same as the power actually available for economic development. The facts are given in Table 21.

TABLE 21.—*Indicated horsepower developed by Tallulah River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 months.
Tallulah River:										
	Miles	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to foot of Tallulah Falls	2.5	192	259	388	[a] 229	5,380	8,070	760	1,520	3,040
From foot of Tallulah Falls to head of falls	1	191	260	390	365	8,640	13,000	2,950	5,900	11,800
From bridge at head of falls to 2 miles above falls	2	188	257	386	130	3,050	5,380	1,060	2,120	4,240
From 2 miles above falls to Persimmon Creek	29	133	186	279	[b] 280	4,730	7,100	800	1,600	3,200
From Persimmon Creek to head	10	[c] 61	85	128	[d] 330	2,550	3,820	None.	None.	None.
Total	......	....	....	....	......	24,350	37,370	5,570	11,140	22,280

[a] Fall reduced to 104 feet by proposed upper Chattooga reservoir.
[b] Fall reduced to 110 feet by Tallulah reservoir.
[c] Total area.
[d] Mean head.

SENECA RIVER.

Along the first section of 22 miles of Seneca River, viz, from the mouth to Twelve-Mile Creek, there is a rise of about 135 feet. The mean drainage area of 780 square miles produces a minimum discharge of 749 cubic feet per second, which will produce a minimum horsepower of 8,270, or a minimum for the 6 highest months of 12,400. The next section, 5 miles long, lying between the mouth of Twelve-Mile Creek and the confluence of Little and Keowee rivers, has a total fall of about 30 feet, and a minimum discharge of 460 cubic feet per second, which will provide a minimum indicated horsepower of 1,130 and a minimum for the 6 highest months of 1,700. Keowee River, a tributary of the Seneca, 15 miles long from its mouth to the mouth of White Water Creek, has a total fall of 140 feet, which will produce a minimum indicated horsepower of 2,860. White Water Creek, above mentioned, along its lower 5 miles, has a fall of 80 feet, with a minimum discharge of 150 cubic feet per second, which will produce a minimum of 981 indicated horsepower. The remaining 6 miles of White Water River has a total fall of about 2,500 feet, and the mean working head for power development has been considered as 1,200 feet. The minimum discharge is 60 feet per second, which will provide for a minimum of 6,540 indicated horsepower, or a minimum during the 6 highest months of 9,810. This is an exceptionally good power stream for comparatively small installation. Twelve-Mile Creek, another tributary of the Seneca, is 26 miles long from mouth to head, and has a mean fall of 300 feet, which will produce a minimum indicated horsepower of 4,140. Other tributaries of the Seneca are Little River, with a working head of 180 feet and a minimum indicated horsepower of 2,700; also, Estatoe Creek, with a working head of 340 feet and a minimum indicated horsepower of 1,850. Horsepasture River, a tributary of the White Water, is 20 miles long from mouth to head. The total working head for power development is about 1,430 feet, which will produce a minimum indicated horsepower of about 6,650, with a proper distribution of the unit.

CHATTAHOOCHEE RIVER.

Consideration of power in the Chattahoochee basin is confined to that part of the drainage area above Columbus, Ga., at which point the river has a drainage area of 4,900 square miles. The distance to the head of the river is 263 miles. Table 22 gives a statement concerning reservoir sites in the basin, and their capacities.

TABLE 22.—*Selected reservoir sites in the Chattahoochee River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cubic feet.*	*Square miles.*	*Feet.*	*Acres.*
Chattahoochee River north of Gainesville, Ga	350	2.34	820	24,360	320	140	11,110
Chestatee River northwest of Gainesville, Ga	140	2.34	330	10,640	140	100	7,300
Chestatee River east of Dahlonega, Ga	150	2.34	350	3,300	40	100	2,260
Chattahoochee River east of White County, Ga	110	2.34	260	5,520	70	100	3,790

The facts concerning indicated horsepower in the various sections from Columbus to Santee Creek are set forth in Table 23.

Table 23.—*Indicated horsepower developed by Chattahoochee River between Columbus and Santee Creek.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Chattahoochee River:										
From Columbus to West Point.	*Miles.* 35	*Sq. miles.* 4,100	*Sec. ft.* 2,100	*Sec. ft.* 3,360	*Feet.* 325	62,000	99,000	44,600	89,200	178,400
From West Point to Franklin	38	....	1,800	2,880	68	11,100	17,700	9,300	18,600	37,200
From Franklin to Oakdale	65	....	1,500	2,400	101	13,800	22,000	13,800	27,600	55,200
From Oakdale to Roswell	17	1,450	1,280	2,050	101	11,700	18,700	13,800	27,600	55,200
From Roswell to Norcross	13	1,200	1,100	1,760	28	2,790	4,460	3,800	7,600	15,200
From Norcross to Chestatee River	27	1,040	1,040	1,660	63	5,960	9,540	8,650	17,300	34,600
From Chestatee River to Soque River	40	450	540	864	[a]168	8,260	13,200	2,950	5,900	11,800
From Soque River to Leaf Station	3	152	228	365	71	1,480	2,360	1,220	2,440	4,880
From Leaf Station to Santee Creek	10	130	195	292	84	1,480	2,230	1,440	2,880	5,760
Total	......	....	....	....	......	118,570	189,190	99,560	199,120	398,240

[a] Fall reduced to 65 feet by proposed Gainesville reservoir.

Tributaries.—The Chestatee River, an important tributary of the Chattahoochee, is 56 miles long and has a total drainage area of 320 square miles. The lower 18 miles of the river have a fall of 120 feet, and, as the minimum discharge of the section is 336 cubic feet per second, the indicated horsepower is 3,300 and the minimum for the 6 highest months would be 4,950 horsepower. The increase from storage would be 1,880 horsepower with full reservoir capacity distributed over six months, although the fall would be reduced to 24 feet by the Chestatee reservoir. The next 19 miles from the top of the dam at New Bridge has a fall of 145 feet, which would develop an indicated horsepower of 2,840. Another important tributary of the Chattahoochee is the Soque, which in 6 miles has a fall of 116 feet and a minimum discharge of 197 cubic feet per second. This will produce a minimum indicated horsepower of 1,870, or a minimum for the 6 highest months of 2,800.

COOSA RIVER.

The Alabama River, a tributary of the Mobile River system, is formed by the junction of the Coosa and Tallapoosa rivers, a few miles above Montgomery, Ala. In this paper the consideration of power is confined to the Coosa River drainage area. The Coosa

River forks at Rome, Ga., and above this point the south branch is known as the Etowah and the north branch as the Oostanaula. The characteristics of selected reservoir sites are set forth in Table 24.

TABLE 24.—*Selected reservoir sites in the Alabama River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Square miles.*	*Feet.*	*Acres.*
Etowah River, Dawson County, Ga.	270	2.54	680	6,020	80	100	4,200
Etowah River, east of Cartersville, Ga.	920	2.54	2,300	63,560	800	180	24,000
Oostanaula River, near Rome, Ga.	1,670	2.25	3,800	3,200	40	40	5,640
Pinelog Creek, northeast of Rome, Ga.	110	2.25	250	2,000	30	50	2,840
Coosawattee River, Gordon County, Ga.	531	2.34	1,200	2,200	30	30	5,040
Conasauga River, east of Dalton, Ga.	470	2.25	1,000	18,400	250	50	25,600
Conasauga River, above last section	150	2.25	340	7,700	110	50	10,720
Coosa River, above Gadsden, Ala.	5,540	1.76	10,560	9,800	130	45	15,200

The indicated horsepower developed by the Coosa River along various sections from Wetumpka to Rome is set forth in Table 25.

TABLE 25.—*Indicated horsepower developed by Coosa River between Wetumpka and Rome.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 months.
Coosa River:										
From Wetumpka to Town Creek.	*Miles.* 16	*Sq. miles.* 10,000	*Sec. ft.* 4,000	*Sec. ft.* 6,800	*Feet.* 78	28,400	48,300	28,000	56,000	112,000
From Town Creek to Hatchet Creek.	14	9,500	3,800	6,460	36	12,400	21,200	12,800	25,600	51,200
From Hatchet Creek to Waxahatchee Creek.	15	9,000	3,600	6,120	89	29,200	49,600	31,700	63,400	126,800
From Waxahatchee Creek to Beeswax Creek.	15	8,500	3,400	5,780	30	9,180	15,600	10,600	21,200	42,400
From Beeswax Creek to Tallasseehatchee Creek.	16	8,000	3,200	5,440	8	2,360	4,000	2,900	5,800	11,600
From Tallasseehatchee Creek to Choccolocco Creek.	30	7,500	3,000	5,100	42	11,500	19,600	15,000	30,000	60,000
From Choccolocco Creek to below Lock No. 3.	32	7,000	2,800	4,760	26	6,640	11,250	9,300	18,600	37,200
From foot of Lock No. 3 to head of Lock No. 1.	5	6,500	2,600	4,420	21	4,900	8,320	7,400	14,800	29,600
Total.						104,580	177,870	117,700	235,400	470,800

From Wetumpka up to Greensport, a distance of about 140 miles, the slope is comparatively steep. Plans for the canalization of this river for navigation involve the construction of a series of 31 locks and dams, which would practically utilize all the fall between the two points. Thus, the statement of indicated horsepower approximates that which could be economically developed in practice. Above Lock No. 1 at Greensport the river extends 130 miles to Rome, but the fall is only 55 feet and no waterpower is available.

The Oostanaula River, the northern affluent of the Coosa, is formed at Resaca by the junction of the Coosawattee and the Connasauga. This point is 43 miles above Rome. Along this stretch there is a total fall of 50 feet, which is a little more than 1 foot per mile, and, therefore, the country is not well adapted for the development of power. The Coosawattee, from its mouth 22 miles up to Talking Rock, has a fall of 62 feet. The drainage area for the section is 680 square miles and the minimum discharge 476 cubic feet per second, which will provide a minimum indicated horsepower of 2,410. From Talking Rock up to the head of the river at Ellijay, a distance of 23 miles, there is a total fall of 582 feet. The mean drainage area for the section is 300 square miles and the minimum flow is 345 cubic feet per second, which will provide a minimum indicated horsepower of 16,500. As the river along this section is a continuous shoal, the entire fall is available for development. Hence the figure given above can be easily realized in actual practice. Cartecay River, an important tributary of the Coosawattee, has a fall of 390 feet in the 15 miles from the mouth up to Pumpkin Creek. The mean discharge is 144 cubic feet per second; the minimum indicated horsepower produced is, therefore, 4,590, and the minimum for the 6 highest months is 6,880.

The Connasauga River, the other affluent of the Oostanaula, has a minimum indicated horsepower of 6,650, distributed along the 32 miles of the river from Beaverdale to the head and along the Jack River, a tributary of the Connasauga.

ETOWAH RIVER.

We come now to the Etowah River, the southern affluent of the Coosa. The horsepowers developed by various sections of the river are shown in Table 26.

TABLE 26.—*Indicated horsepower developed by Etowah River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 months.
Etowah River:	*Miles.*	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to Euharlie Creek.	31	1,720	912	1,370	72	5,970	8,950	16,000	32,000	64,000
From Euharlie Creek to Cartersville	15	1,270	698	1,050	36	2,290	3,430	8,000	16,000	32,000
From Cartersville to Owl Creek	10	1,040	624	936	[a] 84	4,750	7,130	14,000	28,000	56,000
From Owl Creek to Little River.	7	935	608	912	17	945	1,420	Submerged.		
From Little River to Amicalola River	36	490	441	662	[b] 225	9,000	13,500	1,800	3,600	7,200
From Amicalola River to Nimblewill Creek	20	110	110	165	315	3,150	4,720	None.	None.	None.
From Nimblewill Creek to Jones Creek	1	43	47	70	27	115	173	None.	None.	None
From Jones Creek to head	7	[a] 23	25	38	[d] 210	477	716	None.	None.	None.
Total						266,970	40,039	39,800	79,600	159,200

[a] Reduced to 70 feet by proposed Cartersville reservoir.
[b] Reduced to 105 feet by proposed Dawson reservoir.
[c] Total area.
[d] Mean head.

OHIO RIVER TRIBUTARIES.

The tributaries of the Ohio River considered in this discussion are the Monongahela, Great Kanawha, and Tennessee. Two other great streams have their headwaters in the Southern Appalachians, the Kentucky and Cumberland Rivers, but they are not considered in this paper, because the surveys available in their drainage areas cover so small an area that a comprehensive statement concerning the power developed on each can not be made at this time.

MONONGAHELA RIVER.

Monongahela River joins with the Allegheny at Pittsburg to form the Ohio. The drainage area, 7,350 square miles in extent, lies within the States of Pennsylvania, West Virginia, and Maryland. A short distance above the confluence of the Monongahela with the Allegheny, the Youghiogheny enters. This stream has a drainage area of 1,750 square miles.

Monongahela River has been extensively canalized for navigation, there being 15 locks and dams between the mouth and Fairmont, W. Va. The effect of these dams, so far as power is concerned, is to concentrate the natural fall of the river at 15 points, which would provide excellent water-power facilities, if the amount of summer flow were sufficient to make development worth while. Therefore, it will be seen that the preservation of summer flow, through the forestation of the uplands and the installation of reservoirs, is one of the directly important features of improvement in these drainage areas. From among the many reservoir sites that appear upon a survey of the basin, those shown in Table 27 have been selected as producing the best combination for all purposes.

TABLE 27.—*Selected reservoir sites in the Monongahela River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Square miles.*	*Feet.*	*Acres.*
Dunkard Creek, Cass County, W. Va.	160	1.7	270	8,300	150	100	5,800
Buffalo Creek, Mannington, W. Va.	40	1.7	70	2,400	40	59	2,100
Booths Creek, Monongah, W. Va.	40	1.7	70	2,800	40	101	1,600
Sandy Creek, Grafton, W. Va.	80	1.7	140	6,200	80	155	3,600
Teter Creek, Nestorville, W. Va.	40	1.7	60	2,600	40	115	1,300
Elk Creek, Clarksburg, W. Va.	100	1.7	170	5,900	100	92	4,500
West Fork River, Clarksburg, W. Va.	380	1.7	640	24,700	380	109	15,900
Buckhannon River, Buckhannon, W. Va.	310	1.7	530	18,800	310	77	13,300
Middle Fork Tygart, Barbour County, W. Va.	140	1.7	230	8,100	140	107	4,300
Cheat River, Tucker County, W. Va.	820	1.7	1,400	23,800	440	200	6,600
Tygart River, Beverly, W. Va.	330	1.7	560	19,100	330	142	10,000

Monongahela River is formed a short distance above Fairmont, W. Va., by the junction of Tygarts Valley River and West Fork. The indicated horsepower developed by the main stem is set forth in Table 28.

TABLE 28.—*Indicated horsepower developed by Monongahela River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 highwater months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Monongahela River:										
From lower level Dam No. 1 to upper level Dam No. 4	*Miles* 39.2	*Sq. miles.* 6,280	*Sec. ft.* 879	*Sec. ft.* 3,450	*Feet.* 28.8	2,300	9,030	9,080	18,200	36,400
From lower level Dam No. 5 to upper level Dam No. 6	9.8	4,790	671	2,640	23.0	1,400	5,520	7,250	14,500	29,000
From lower level Dam No. 7 to upper level Dam No. 9	10.6	3,600	504	1,980	29.7	1,360	5,340	8,120	16,200	32,400
From lower level Dam No. 10 to upper level Dam No. 15	21.4	2,510	351	1,350	57.6	1,840	7,070	13,000	26,000	52,000
Total						6,900	26,960	37,450	74,900	149,800

In connection with Table 28, special consideration should be given to the amount of power available from storage. Here is a river canalized by the Government at an expense of over $6,000,000, and which might be made to produce enormously profitable return on this investment if the work were completed by the reservation and forestation of the uplands and by the establishment of the necessary reservoir system. On the basis of a distribution of the stored waters over the entire year the income from water-power rental at an average of $20 per horsepower per year would be $885,000, or equivalent to a 3 per cent income on an investment of $29,500,000.

TYGARTS VALLEY RIVER.

This affluent of the Monongahela River is 121 miles long from source to mouth, and has a total drainage area of 1,420 square miles. The indicated horsepower developed along the river is set forth in Table 29.

TABLE 29.—*Indicated horsepower developed by Tygarts Valley River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Tygarts Valley River:										
From above West Fork River to below junction Frog Run	*Miles.* 28	*Sq. miles.* 1,320	*Sec. ft.* 251	*Sec. ft.* 990	*Feet.* 121	2,760	10,900	16,700	33,400	66,800
From below junction Frog Run to below Buckhannon River	23	1,080	238	918	288	6,230	24,000	35,700	71,400	142,800
From above Buckhannon River to below junction of Middle Fork	3.5	596	143	566	139	1,810	7,150	10,000	20,000	40,000
From above junction Middle Fork to above Roaring Creek	16.5	379	95	375	225	1,940	7,670	11,500	23,000	46,000
From 2 miles above Roaring Creek to below Pound Mill Run	31	205	51	203	252	1,170	4,650	Partly submerged.		
From below Pound Mill Run to source	19	[a] 88	22	87	[b] 1,800	900	3,560	None.	None.	None.
Total						14,810	57,930	73,900	147,800	295,600

[a] Total area.

[b] 25 per cent total fall.

WEST FORK.

West Fork, which joins with the Tygarts Valley River to form the Monongahela, is not well adapted for the development of extensive power. Along the first 70 miles of its course, from the mouth to Washburn Run, the fall is only 160 feet. In the next 22 miles, to the head of the river, the fall is 500 feet, but the drainage area is small.

OTHER TRIBUTARIES OF MONONGAHELA RIVER.

Cheat River.—Cheat River is an important tributary, entering the Monongahela from the east some distance below Morgantown, W. Va. The indicated horsepower developed at selected sections along the stream is set forth in Table 30.

TABLE 30.—*Indicated horsepower developed by Cheat River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Cheat River:										
	Miles	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to Albright........	29	1,220	171	720	360	5,600	23,600	24,200	48,400	96,800
From above Albright to below junction Dry Fork......	45	865	121	510	[a] 397	4,360	18,400	18,800	37,600	75,200
From above junction Dry Fork to 3,000-foot contour...	45	151	21	89	1,230	2,350	9,950	Partly submerged.		
From 3,000-foot contour to source.........	30	[b] 88	12	52	[c] 375	410	1,780	None.	None.	None.
Total........	......	....	....	....	......	12,720	53,730	43,000	86,000	172,000

[a] Fall reduced to 280 feet by proposed Cheat reservoir. [b] Total area. [c] 25 per cent total fall.

Buckhannon River.—This river is 61 miles long and its basin is 350 square miles in extent. The first section of 11 miles above the mouth has a total fall of 60 feet. The minimum flow in cubic feet per second is 66, while the minimum for the 6 highest months is 261. This will produce a minimum indicated horsepower of 324 and a minimum for the 6 highest months of 1,280 horsepower. Along the next 33 miles of the course, from Sand Run to Alexander, the total fall is 470 feet, and the minimum flow 40 cubic feet per second, which will produce a minimum indicated horsepower of 1,540. The minimum for the 6 highest months is 6,070. From Alexander to the source of the river, a distance of 17 miles, there is a fall of 1,300 feet, but the drainage area is only 90 square miles in extent, so the power available for development is inconsiderable.

Middle Fork.—Along the lower 25 miles of this fork there is a total fall of 540 feet and a mean drainage area of 113 square miles, producing a minimum flow of 25 cubic feet per second, or an indicated minimum horsepower of 1,100. The upper 15 miles of the river has a fall of 1,200 feet, but the drainage area is only 65 square miles in extent and the power actually available is limited.

Other tributaries of considerable importance as sources of power are Dry Fork, Laurel and Gladys forks, Black Water River, Dunkard and Sandy creeks.

Youghiogheny River.—This river enters the Monongahela at McKeesport, above which point it has a total drainage area of 1,750 square miles. Survey of reservoir sites has been made over only a part of its basin, but those identified are shown in Table 31.

TABLE 31.—*Selected reservoir sites in the Youghiogheny River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Square miles.*	*Feet.*	*Acres.*
Youghiogheny River, Friendsville, Md	270	2.47	690	20,270	255	240	4,220
Deep Creek, Garrett County, Md	55	2.47	136	4,603	58	83	3,200
Cherry Creek, Garrett County, Md.	55	2.47	136	4,912	62	64	3,930
Muddy Creek, Garrett County, Md.	13	2.47	32	1,065	13	70	1,100
Harrington Creek, Garrett County, Md	13	2.47	32	900	11	60	760

It is probable that, were surveys available on the remainder of the drainage area, it would be found that the storage capacity on the upper Youghiogheny would be from two and one-half to three times that expressed in the above table. The indicated horsepower along the river from McKeesport to the source, not including Laurel Hill and Castleman rivers, is set forth in Table 32.

TABLE 32.—*Indicated horsepower developed by Youghiogheny River between McKeesport and the source.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 monhts.
Youghiogheny River:										
From McKeesport to West Newton	*Miles.* 19	*Sq. miles.* 1,650	*Sec. ft.* 297	*Sec. ft.* 1,170	*Feet.* 27	730	2,870	2,360	4,720	9,440
From West Newton to Connellsville	26.5	1,400	252	990	111	2,540	10,000	9,700	19,400	38,800
From Connellsville to Confluence	17.5	1,120	202	795	408	7,500	29,400	35,700	71,400	142,800
From Confluence to Friendsville	15	365	80	288	[a] 122	890	3,190	2,800	5,600	11,200
From Friendsville to Little Youghiogheny River	26	204	45	161	810	3,320	11,900	18,000	36,000	72,000
From below junction Little Youghiogheny River to source	37	[b] 112	25	88	[c] 87.5	200	700	370	740	1,480
Total						15,180	58,060	68,930	137,860	275,720

[a] Fall reduced to 32 feet by proposed Youghiogheny reservoir.
[b] Total area.
[c] 25 per cent total fall. Fall reduced 64 feet by proposed Cherry Creek reservoir.

GREAT KANAWHA RIVER.

The main stem of Great Kanawha River extends from the Ohio River 98 miles to the junction of Gauley River. Above this point the river is known as New River, extending 255 miles to the junction of North and South forks. The lower 96 miles of Kanawha River is canalized to insure a minimum depth of 6 feet for navigable purposes. For the first 79 miles, or up to the confluence of Paint Creek, canalization is accomplished by movable dams, 8 in number, and for the remainder of the distance by fixed dams, 2 in number. The presence of these movable dams forbids the installation of power systems along that portion of the river, and since the very object of installing movable dams is to provide for open navigation, this, of course, would be defeated by the introduction of fixed dams. This part of the river may, therefore, be disregarded so far as power development is concerned, although the minimum indicated horsepower along this portion of the stream, as shown by its minimum flow and its natural slope, is nearly 20,000. The slope is exceedingly gradual, however, and it is doubtful if any considerable part of this power could be developed without unreasonable expenditure, even if the present system of movable dams had not been installed. In fact, it is clear that the river along this part is far more important as a waterway than as a source of power. The indicated horsepower from the foot of Loup Creek Shoal up to the confluence of North and South forks of New River is set forth in Table 33.

TRIBUTARIES OF GREAT KANAWHA RIVER.

SOUTH FORK OF NEW RIVER.

South Fork of New River is 78 miles long and in the lower 55 miles of its course has a total fall of 500 feet. The mean drainage area for the section is 207 square miles and the minimum discharge 145 cubic feet per second, which will produce a minimum indicated horsepower of 5,930, or a minimum for the 6 highest months of 10,200.

NORTH FORK OF NEW RIVER.

North Fork of New River is 42 miles long, and along the lower 28 miles of its course there is a total fall of 390 feet. The mean drainage area is 170 square miles, which produces a minimum flow of 85 cubic feet per second. This will provide for a minimum indicated horsepower of 2,710, or a minimum for the 6 highest months of 5,420.

Table 33.—*Indicated horsepower developed by Great Kanawha River between Pool No. 2 and confluence of North and South forks.*

Section of river	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
	Miles	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
Great Kanawha River, from foot of Loup Creek Shoal to below junction Gauley River	9	8,310	2,240	5,810	46	9,370	24,300	27,700	55,400	110,800
New River:										
From above junction Gauley River to 1,000-foot contour	19	6,780	1,830	4,740	316	52,500	136,000	148,000	296,000	592,000
From 1,000-foot contour to 1,200-foot contour	24	6,560	1,770	4,590	180	29,000	75,200	84,400	168,800	337,600
From 1,200-foot contour to below junction Greenbrier River	20	6,300	1,700	4,410	164	25,400	65,700	76,800	153,600	307,200
From above junction Greenbrier River to below junction Island Creek	20	4,220	1,400	3,550	69	8,780	22,300	Submerged.		
From above junction Island Creek to below junction Wolf Creek	17	3,750	1,280	3,220	[a] 66	7,680	19,300	7,300	14,600	29,200
From above junction Wolf Creek to below junction Sinking Creek	19	3,240	1,140	2,850	85	8,800	22,000	23,300	46,600	93,200
From above junction Sinking Creek to head Siffords Falls	8	2,920	1,050	2,600	50	4,780	11,800	13,100	26,200	52,400
From head Siffords Falls to Godbys Ferry	32	2,660	985	2,420	[b] 71	6,360	15,600	11,000	22,000	44,000
From Godbys Ferry to Ashworth	13	2,320	880	2,160	76	6,080	14,900	Submerged.		
From Ashworth to below junction Reed Creek	9	2,020	810	1,900	28	2,060	4,840	2,400	4,800	9,600
From above junction Reed Creek to Union Lead Mines	10	1,450	623	1,400	61	3,450	7,760	3,820	7,640	15,300
From Union Lead mines to 2,200-foot contour	16	1,240	571	1,220	[c] 230	11,900	25,500	3,270	6,540	13,100
From 2,200-foot contour to below junction North Fork	48	875	472	875	270	11,600	21,500	None.	None.	None.
Total						187,760	466,700	401,090	802,180	1,604,400

[a] Fall reduced to 26 feet by proposed lower New River reservoir.
[b] Fall reduced to 42 feet by proposed Radford reservoir.
[c] Fall reduced to 60 feet by proposed Carroll reservoir.

GREENBRIER RIVER.

Greenbrier River has a total drainage area of 1,580 square miles and a length from source to mouth of 151 miles. The reservoir sites on this river propose the conservation of the entire discharge from 1,000 square miles. Therefore, the power available for development with storage reservoirs established will be considerably different from that under the present conditions. The following statement of indicated horsepower along various sections of the river is, therefore, given, without reference to storage possibilities except that in the last three columns there is a statement of the amount of power that would be derived from storage along the sections not submerged by the proposed reservoirs.

Table 34.—*Indicated horsepower developed by Greenbrier River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Greenbrier River:	*Miles*	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to below Second Creek	36	1,460	161	481	234	3,420	10,200	30,600	61,200	122,400
From above Second Creek to below Anthony Creek	23	1,100	121	363	[a] 198	2,180	6,530	19,000	38,000	76,000
From above Anthony Creek to below Knapp Creek	40	670	74	221	[a] 270	1,820	5,430	6,060	12,120	24,240
From above Knapp Creek to below North Fork	21	326	36	108	[b] 279	910	2,740	6,700	13,400	26,800
From above North Fork to below East Fork	13	148	16	49	234	340	1,040	None.	None.	None.
From below junction East Fork to source	18	[c] 130	14	43	[d] 250	318	980	None.	None.	None.
Total						8,988	26,920	62,360	124,720	249,440

[a] Fall reduced to 145 feet by proposed Lewisburg reservoir.
[b] Fall reduced to 160 feet by proposed Pocahontas reservoir.
[c] Total area.
[d] 25 per cent total fall.

GAULEY RIVER.

Gauley River has a total drainage area of 1,430 square miles and from source to mouth is 108 miles long. The conditions with reference to storage and its effects on available power are similar to those already described for Greenbrier River. Table 35 shows indicated horsepower along chosen sections, together with a statement of the power available from storage along those sections not submerged by the proposed reservoirs.

TABLE 35.—*Indicated horsepower developed by Gauley River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 months.
Gauley River:										
From mouth to below junction Meadow River.	*Miles* 27	*Sq. miles.* 1,310	*Sec. ft.* 354	*Sec. ft.* 917	*Feet.* [a] 432	13,900	36,000	9,270	18,500	37,000
From above Meadow River to below junction Cranberry River....	31	573	155	400	693	9,760	25,200	3,310	6,630	13,260
From above junction Cranberry River to below junction Williams River	17	209	56	146	252	1,280	3,350	None.	None.	None.
From below junction Williams River to source.........	33	[b] 181	49	127	[c] 500	2,230	5,770	None.	None.	None.
Total..						27,170	70,320	12,580	25,130	50,260

[a] Fall reduced to 300 feet by proposed Gauley reservoir. [b] Total area. [c] 25 per cent total fall.

Tributaries of Gauley River.—Indicated horsepower on tributaries of Gauley River is given in Table 36.

TABLE 36.—*Indicated horsepower developed by tributaries of Gauley River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 months.
Meadow River:										
From mouth to 1,800-foot contour..........	*Miles.* 8	*Sq. miles.* 350	*Sec. ft.* 95	*Sec. ft.* 245	*Feet.* 603	5,200	13,400	13,700	27,400	54,800
From 1,800-foot contour to 2,200-foot contour...........	11	295	80	206	360	2,620	6,740	8,200	16,400	32,800
From 2,200-foot contour to below Big Clear Creek....	18	222	60	155	270	1,470	3,800	5,700	11,400	22,800
From below Big Clear Creek to source.........	19	[a] 165	45	115	[b] 350	1,430	3,660	Submerged.		
Hominy Creek, from mouth to source...........	18	[a] 98	26	69	[b] 375	890	2,350	None.	None.	None.
Muddlety Creek, from mouth to source...........	22	[a] 66	18	46	[b] 250	409	1,050	Submerged.		
Cherry Creek, from mouth to source.	25	[a] 168	45	118	[b] 500	2,050	5,360	None.	None.	None.
Cranberry River, from mouth to source...........	30	[a] 102	28	71	[b] 525	1,340	3,390	None.	None.	None.
Twenty-mile Creek from mouth to source...........	30	[a] 75	20	52	[c] 350	636	1,650	....	....	....
Total..						16,045	41,400	27,600	55,200	110,400

[a] Total area. [b] 25 per cent total fall. [c] Fall reduced 220 feet at mouth by proposed Gauley reservoir.

ELK RIVER.

Elk River, which enters the Kanawha at Charleston, is 171 miles long and has a total drainage area of 1,550 square miles. Of this area, the proposed reservoir in Clay County would conserve all the flow from 940 square miles. Therefore, an estimate of power with the reservoir constructed would be totally different from the estimate under the present conditions, which are similar to those already described for Greenbrier River. The indicated horsepower on the main stream is set forth in Table 37.

TABLE 37.—*Indicated horsepower developed by Elk River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of— 12 months.	6 months.	3 months.
Elk River:										
From mouth to below junction Buffalo Creek..	*Miles* 51	*Sq. miles.* 1,280	*Sec. ft.* 346	*Sec. ft.* 895	*Feet.* 135	4,250	11,000	16,900	33,800	67,600
From above junction Buffalo Creek to below junction Birch Creek....	25	832	225	583	[a] 45	920	2,380	None.	None.	None.
From above junction Birch Creek to below junction Holly Creek..........	30	552	149	386	162	2,200	5,690	Submerged.		
From above junction Holly Creek to below junction Back Fork...........	25	282	76	197	505	3,490	9,040	None.	None.	None.
From below junction Back Fork to source.	40	[b] 227	61	159	[c] 625	3,470	9,040	None.	None.	None.
Total........	......	....	....	....	....	14,330	37,150	16,900	33,800	67,600

[a] Fall reduced about 25 feet by proposed Elk River reservoir. [b] Total area. [c] 25 per cent total fall.

Tributaries of Elk River.—The principal tributaries of Elk River are Holly and Birch rivers and Buffalo Creek, which furnish minimum indicated horsepowers of 1,860, 1,730, and 990, respectively.

TENNESSEE RIVER.

The Tennessee is one of the most important rivers in the United States, both from the standpoint of navigation and of available water power. Its basin includes an enormous area in the Appalachian Mountains, and its value as a public resource is, therefore, markedly affected by the conditions prevailing in that region. The devastation of the protective forest cover in these mountains would not only reduce all the power and navigation values along the stream, but would also result in a denudation of alluvial lands now fertile and productive. The total loss to the valley could hardly be overestimated.

The lower section, between Riverton and the mouth, is not considered in this report. This portion is essentially a great commercial highway, and its very gradual slope renders it impossible to develop power to advantage. Above Riverton it has a total drainage area of 30,800 square miles, and a minimum discharge of 12,000 cubic feet per second.

Storage facilities in the basin are enormous. Table 38 contains the facts concerning certain chosen reservoir sites, which are of a sufficient capacity to conserve the annual run-off from an area of 12,800 square miles.

TABLE 38.—*Selected reservoir sites in the Tennessee River basin.*

Stream and location.	Catchment area.	Mean annual run-off per square mile.	Flow available.	Capacity of reservoir.	Capacity of reservoir in catchment area.	Height of dam.	Area of flow line.
	Square miles.	*Cu. feet per sec.*	*Cu. feet per sec.*	*1,000,000 cu. feet.*	*Square miles.*	*Feet.*	*Acres.*
Clinch River, Scott County, Va	780	1.38	1,080	30,400	690	180	10,000
Nolichucky River, Greenville, Tenn	940	1.69	1,590	14,700	270	100	10,200
Clinch River, Sneedville, Tenn	560	1.38	770	18,500	390	100	8,500
Powell River, Jonesville, Va	570	1.38	790	17,100	380	100	12,000
Holston River, northeast of Knoxville, Tenn	3,400	1.56	5,300	163,500	3,300	160	49,000
French Broad River, east of Knoxville, Tenn	4,050	1.56	6,300	199,600	4,000	200	70,000
Little River, south of Knoxville, Tenn	290	1.56	450	17,400	290	94	12,100
Little Tennessee River, Loudon County, Tenn	2,520	2.78	7,000	78,000	860	100	54,400
Little Tennessee River, Swain County, Tenn	380	2.78	1,050	7,340	80	100	5,120
Clinch River, Roane County, Tenn	2,110	1.38	2,900	26,500	600	60	30,000
Cheoah River, Graham County, N. C	180	2.78	500	6,700	75	150	2,840
Hiwassee River, Cherokee County, N. C	550	2.63	1,450	32,400	380	200	11,080
Nottely River, Union County, Ga	240	1.70	410	1,000	20	40	1,680
Toccoa River, Fannin County, Ga	240	2.14	510	4,130	60	100	2,880
Hiwassee River, Hiwassee, Ga	100	2.63	260	2,240	40	100	1,600
Tennessee River, Rabun County, Ga	50	4.35	220	2,720	20	50	3,800
Hiwassee River, near mouth, Tenn	2,040	2.12	4,300	77,500	1,130	70	70,000
West Chickamauga Creek, Walker County, Ga	80	2.00	160	5,260	80	60	6,300
South Chickamauga Creek, Catoosa County, Ga	110	2.00	220	6,330	100	60	7,400
Sequatchie River, Sequatchie County, Tenn	330	2.00	660	4,000	60	50	5,500

It is doubtful whether it would be wise to install the whole of the great conservation system indicated in the above table. There has been no opportunity for a critical study of this subject, and the facts given merely show the possibilities for storage.

Considering the main stream from Riverton to the mouth of Holston River, there are two sections along which a great horsepower is indicated. The first section from Riverton to the head of Elk Shoals is 60 miles long and has a total fall of 165 feet. The minimum indicated horsepower thereby produced is 162,000 and the minimum for the 6 highest months would be 275,000. The increase from storage, considering full reservoirs, would be as follows:

Distributed over 1 year	396,000
Distributed over 6 months	792,000
Distributed over 3 months	1,584,000

The next section extends from The Pan to Chattanooga, a distance of 20 miles, with a total fall of 28 feet. The minimum discharge along this section is 10,000 cubic feet per second, giving a minimum indicated horsepower of 22,900, or a minimum for the 6 highest months of 38,900. This would be increased by storage, considering full reservoirs, as follows:

Distributed over 1 year	67, 000
Distributed over 6 months	134, 000
Distributed over 3 months	268, 000

A short distance above Knoxville, Tenn., the Hiwassee and French Broad rivers join to form the Tennessee.

HIWASSEE RIVER.

From the mouth of the Hiwassee to Ocoee River, a distance of 35 miles, the fall is only 33 feet; therefore, this stretch is not available for the practical development of power. The indicated horsepower for the remainder of the stream is set forth in Table 39.

TABLE 39.—*Indicated horsepower developed by Hiwassee River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Hiwassee River:										
	Miles	*Sq. miles.*	*Sec. ft*	*Sec. ft.*	*Feet.*					
From Ocoee River to Savannah Ferry	9	1,310	972	1,560	20	1,750	2,790	Submerged.		
From Savannah Ferry to Reliance	6	1,220	915	1,460	36	3,000	4,800	3,500	7,000	14,000
From Reliance to Coco Creek	9	1,150	874	1,400	153	12,200	19,400	17,000	34,000	68,000
From Coco Creek to Turtletown Creek	3	1,060	806	1,290	[a]231	15,200	24,300	23,100	46,200	92,400
From Turtletown Creek to Apalachia, Tenn	3									
From Apalachia, Tenn., to Apalachia, N. C	2									
From Apalachia, N. C., to Beaverdam Creek	14	1,000	780	1,250	131	9,270	14,800	Submerged.		
From Beaverdam Creek to Nottely River	15	910	710	1,140	136	8,780	14,000	Submerged.		
From Nottely River to Valley River	5	560	437	699	46	1,830	2,920	Submerged.		
From Valley River to Brasstown Creek	7	390	320	512	63	1,840	2,930	445	890	1,780
From Brasstown Creek to Shooting Creek	18	240	240	384	205	4,470	7,160	1,450	2,900	5,800
From Shooting Creek to Hightower Creek	10	110	121	194	117	1,290	2,060	670	1,340	2,680
Total	.....	....	....	....	......	59,630	95,160	46,165	92,330	184,660

[a] Mean head.

Tributaries of Hiwassee River.—The principal tributary of the Hiwassee is the Ocoee, which has a total drainage area of 635 square miles. Along the upper 57 miles of its course the name Toccoa is given to the river. The indicated horsepower along the entire section is set forth in Table 40.

TABLE 40.—*Indicated horsepower developed by Ocoee-Toccoa River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Ocoee River:										
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to Sylco Creek	16	600	600	960	70	3,830	6,140	567	1,134	2,268
From Sylco Creek to Big Creek	3	550	578	925	57	2,980	4,770	745	1,490	2,980
From Big Creek to Bush Creek.	13	500	550	880	522	26,100	41,800	6,850	13,700	27,400
FromBush Creek to Fightingtown Creek	5	440	506	810	34	1,580	2,520	Limited amount.		
Toccoa River:										
From above Fightingtown Creek to Blue Ridge Station, Morganton Bridge	15	300	390	624	92	3,260	5,210	1,210	2,420	4,840
From Blue Ridge to Dial Station.	21	180	252	403	280	6,440	10,300	Fall reduced one-third by Toccoa reservoir.		
From Dial Station to Coopers Creek	7	100	145	232	153	2,020	3,220	None.	None.	None.
Total						46,210	73,960	9,372	18,744	37,488

EXPLANATORY NOTE.—Mouth of Ocoee to Sylco Creek—fall reduced 30 feet by proposed Hiwassee reservoir.

The remaining tributaries of Hiwassee River afford good power sites for limited development, but the drainage areas are, in the main, so small that they will not be considered in this report except in the case of Nottely River, which enters the Hiwassee near Murphy, Tenn. The Nottely develops an indicated horsepower as follows: From the mouth to Ranger, a distance of 9 miles, there is a total fall of 85 feet and a minimum discharge of 224 cubic feet per second, which will provide for a minimum indicated horsepower of 1,560. The minimum for the 6 highest months is 2,490. From Ranger to Young Cane Creek, a distance of 20 miles, there is a fall of 155 feet and a minimum flow of 187 cubic feet per second, which will provide for a minimum indicated horsepower of 2,380. The minimum for the 6 highest months is 3,800. This power would be obliterated by the Nottely reservoir.

CLINCH RIVER.

The tributary of the Tennessee River of next importance is Clinch River, which has a drainage area of 4,390 square miles. The indicated horsepower along this stream is set forth in Table 41.

TABLE 41.—*Indicated horsepower developed by Clinch River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Clinch River:										
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From Emory Creek to Clinton	55	3,200	960	1,440	68	5,895	8,840	Submerged.		
From Clinton to Powell River	31	2,840	852	1,280	50	3,834	5,740	10,300	20,600	41,200
From Powell River to near Sycamore Creek, Southern Railway bridge	48	1,740	522	783	133	6,318	9,450	20,600	41,200	82,400
From near Sycamore Creek, Southern Railway bridge, to North Clinch River	45	1,450	435	652	171	6,750	10,100	19,500	39,000	78,000
From North Clinch River to Clinchport station	20	1,070	321	482	54	1,575	2,360	Submerged.		
From Clinchport station to Indian Creek	110	550	165	248	680	10,125	15,210	8,600	17,200	34,400
Total	......	....	....	....	......	34,497	51,700	59,000	118,000	236,000

EXPLANATORY NOTES.—Fall between Southern Railway bridge and North Clinch River reduced to 140 feet by Sneedville reservoir. Fall between Clinchport and Indian Creek reduced to 100 feet by Clinch River reservoir.

Tributaries of Clinch River.—The most important tributary is Powell River, which has a total drainage area of 940 square miles. The amount of indicated horsepower along various sections of this river and designated tributaries is set forth in Table 42.

TABLE 42.—*Indicated horsepower developed by Powell River and tributaries.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Powell River:	*Miles.*	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to North Powell..	100	610	183	274	387	6,440	9,630	9,640	19,280	38,560
From North Powell to South Powell..	17	170	51	76	198	918	1,380	None.	None.	None.
From South Powell to Callihan Creek....	4	101	30	45	54	144	216	None.	None.	None.
North Fork, Powell River, from mouth to head..	17	[a]91	27	40	[b]330	810	1,220	None.	None.	None.
South Fork, Powell River, from mouth to head..	12	[a]37	11	16	[b]730	730	1,100	None.	None.	None.
Copper Creek, from mouth to head..	41	[a]136	41	62	[b]336	1,250	1,880	None.	None.	None.
Guest River, from mouth to head..	19	[a]96	29	44	[b]480	1,270	1,900	None.	None.	None.
Maiden Spring Creek, from mouth to head..	35	[a]119	36	54	[b]430	1,400	2,100	None.	None.	None.
Total........	......	....	....	....	......	12,962	19,426	9,640	19,280	38,560

[a] Total area.

[b] Mean head.

EXPLANATORY NOTE.—Water fall between mouth and North Powell reduced to 200 feet by Jonesville reservoir.

LITTLE TENNESSEE RIVER.

Above the Hiwassee and Clinch, on the Tennessee River, is the Little Tennessee, a stream having a total drainage area of 2,650 square miles. The indicated horsepower developed along various sections of this stream is set forth in Table 43.

TRIBUTARIES OF LITTLE TENNESSEE RIVER.

Some of the tributaries of Little Tennessee River are quite as important, from the standpoint of power development, as the main stream itself.

Tellico River is a stream having a total drainage area of 284 square miles. From the mouth to Tellico Plains, a distance of 22 miles, there is a fall of 120 feet, which, with a minimum discharge of 125 cubic feet per second, will furnish a minimum indicated horsepower of 1,224. The minimum for the 6 highest months will be 1,960. This part of the river would be submerged by the proposed Loudon

Table 43.—*Indicated horsepower developed by Little Tennessee River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
Little Tennessee River:										
From mouth to below Tellico River, McGhee Station	20	2,560	2,050	3,280	27	5,030	8,050	6,370	12,740	25,480
From above Tellico, McGhee, to Abrams Creek	19	2,100	1,780	2,850	63	10,200	16,300		Submerged.	
From Abrams Creek to Tuckaseegee River	38	1,670	1,500	2,400	567	77,300	123,000	21,000	42,000	84,000
From Tuckaseegee River to Nantahala River	7	657	650	1,040	90	5,320	8,510	2,820	5,640	11,280
From Nantahala River to below Cullasaja River, Franklin	28	380	418	669	387	14,700	23,500	7,050	14,100	28,200
Total						112,550	179,360	37,240	74,480	148,960

Explanatory Notes.—Fall between mouth and McGhee reduced to 24 feet by Loudon reservoir. Fall between Nantahala and Cullasaja reduced to 250 feet by Swain reservoir.

reservoir. From Tellico Plains to the head of the river is a distance of 18 miles, with a total fall of 1,600 feet. Considering 700 feet of this as a mean working head, with a discharge of 102 cubic feet per second, the total minimum indicated horsepower is 6,490, and the minimum for the 6 highest months will be 10,400.

Citico Creek, a tributary 17 miles long, has a total mean head of 470 feet. The minimum discharge is 58 cubic feet per second, which will provide for a minimum indicated horsepower of 2,480. The available fall would be reduced 40 per cent by the proposed Loudon reservoir.

Abrams Creek, 15 miles long with a drainage area of 94 square miles, has a total fall of 1,110 feet. Considering 580 feet of this as a reasonable mean head, with a minimum discharge of 75 cubic feet per second, there will be developed a total minimum indicated horsepower of 3,950. The minimum for the 6 highest months will be 6,320 horsepower.

Cheoah Creek.—This is another important tributary of Little Tennessee River, with a total drainage area of 212 square miles. From the mouth to Snow Bird Creek, a distance of 13 miles, there is a total fall of 800 feet, with a minimum run-off of 130 cubic feet per second, which will produce a minimum indicated horsepower of 8,500. The minimum for the 6 highest months will be 13,600. On the same river from Snow Bird Creek to Tallula Creek, a distance of 4 miles, there is a total fall of 110 feet, which will produce a minimum horsepower of 396, with a discharge of 44 cubic feet per second. This power would be reduced approximately 50 per cent by the Cheoah reservoir. There are several tributaries of Cheoah Creek, such as Santeetla, Snow Bird, and Tallula creeks, which furnish fairly good sites for limited installation.

Tuckaseegee River.—The most important tributary of Little Tennessee River is the Tuckaseegee, which has a drainage area of 752 square miles. The indicated horsepower along certain sections of this river is shown in Table 44.

TABLE 44.—*Indicated horsepower developed by Tuckaseegee River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Tuckaseegee River:										
From Bryson City to Oconalufty River....	*Miles.* 6	*Sq. miles.* 635	*Sec. ft.* 540	*Sec. ft.* 864	*Feet.* 63	3,100	4,950	....	....	....
From Oconalufty River to Scott Creek..........	16	375	319	510	144	4,180	6,680	....	....	....
From Scott Creek to East Laport Station.	10	245	208	332	108	2,040	3,270	....	....	....
From East Laport Station to West Fork....	6	174	157	251	63	900	1,440	....	....	....
Total........	.....	....	....	....	......	10,220	16,340	....	....	....

The Tuckaseegee itself has important tributaries, the most noticeable of which is the Oconalufty, which has a drainage area of 201 square miles. In the lower 5 miles of this stream there is an approximate fall of 150 feet, with a minimum discharge of 156 cubic feet per second, which will produce a minimum indicated horsepower of 1,920. The minimum for the 6 highest months will be 3,060 horsepower.

Nantahala River.—This river is 43 miles long and has a total drainage area of 180 square miles. Along the first 12 miles there is a total fall of 500 feet and a minimum run-off of 176 cubic feet per second, indicating a minimum horsepower of 7,200. The minimum for the 6 highest months would be 11,500. In the next 18 miles of the river there is a fall of 1,100 feet, about 80 per cent of which could be utilized. The minimum flow is 120 cubic feet per second, which would produce a minimum indicated horsepower of 10,800, and the minimum for the 6 highest months would be 17,300 horsepower. There are many other tributaries of the Little Tennessee providing good power sites for limited installation, but they will not be discussed in this paper.

FRENCH BROAD RIVER.

The main stem of the Tennessee is formed a short distance above Knoxville by the junction of the French Broad and Holston rivers. The former has a total drainage area of 4,810 square miles. The indicated horsepower along chosen sections of the French Broad River is set forth in Table 45.

TABLE 45.—*Indicated horsepower developed by French Broad River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
French Broad River:										
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to Nolichucky River	64	4,430	2,440	3,900	135	30,000	48,000	Submerged.		
From Nolichucky River to Pigeon River	4	2,260	1,360	2,180	4.5	555	888	None.	None.	None.
From Pigeon River to Swannanoa River	64	1,750	1,220	1,950	828	91,800	147,000	None.	None.	None.
From Swannanoa River to East Fork	33	440	440	704	180	7,200	11,500	None.	None.	None.
From East Fork to West Fork	2	66	99	158	9	81	130	None.	None.	None.
From West Fork to head	12	[a] 36	54	86	[b] 710	3,480	5,570	None.	None.	None.
Total						133,116	213,088			

[a] Total area.

[b] Mean head.

TRIBUTARIES OF FRENCH BROAD RIVER.

Little Pigeon River.—This river is 30 miles long and has a total drainage area of 373 square miles. In the first 5 miles of the river, there is a fall of 50 feet, which, with the minimum discharge of 213 cubic feet per second, will give an indicated minimum horsepower of 871. This part of the course would be submerged by the proposed French

Broad reservoir. In the 25 miles above this first section, there is a total fall of 1,900 feet. Considering 480 feet of this as a reasonable working head, and a minimum discharge of 136 cubic feet per second, there is an indicated horsepower of 5,930. West Fork of Little Pigeon River has a drainage area of 142 square miles and a total fall of 1,500 feet in 21 miles. Considering 380 feet as the available working head, and 99 cubic feet per second as the minimum discharge, there is a minimum indicated horsepower of 3,420.

Nolichucky River is an important tributary of French Broad River having a drainage area of 1,760 square miles. The indicated horsepower along this river and tributaries is given in Table 46.

Table 46.—*Indicated horsepower developed by Nolichucky River and tributaries.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Nolichucky River:										
From mouth to Greeneville Station	*Miles.* 48	*Sq. miles.* 1,450	*Sec. ft.* 768	*Sec. ft.* 1,230	*Feet.* 180	12,600	20,200	8,360	16,720	33,440
From Greeneville Station to Toe River, Cane Creek	48	880	484	774	[a] 684	30,100	48,100	6,280	12,560	25,120
Toe River, from mouth to North Toe River and South Toe River	19	360	216	346	277	5,440	8,710	....	....	....
North Toe River, from mouth to head	41	[b] 188	113	181	[c] 510	5,240	8,380	....	....	....
Lick Creek, from mouth to head	30	[b] 262	157	251	[c] 70	1,000	1,600	....	....	....
Cane River, from mouth to Hinton Creek	15	124	87	139	387	3,060	4,900	....	....	....
Cane River, from Hinton Creek to head	20	[b] 64	45	72	[c] 550	2,250	3,600	....	....	....
North Indian Creek, from mouth to head	14	[b] 70	42	67	[c] 360	1,375	2,200	....	....	....
Total	......	....	....	....	......	61,065	97,690	14,640	29,280	58,560

[a] Fall reduced to 150 feet by proposed reservoir. [b] Total area. [c] Mean head.

Pigeon River.—This river is another important tributary of the French Broad, having a total drainage area of 667 square miles. The indicated horsepower along chosen sections of this stream and tributaries is set forth in Table 47.

Table 47.—*Indicated horsepower developed by Pigeon River and tributaries.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Pigeon River:										
From mouth to Cataluchee Creek	*Miles* 35	*Sq. miles.* 560	*Sec. ft.* 308	*Sec. ft.* 493	*Feet.* 504	14,100	22,600	....	....	....
From Cataluchee Creek to Richland Creek	15	312	187	299	720	12,200	19,600	....	....	....
From Richland Creek to West Fork	7	155	124	198	207	2,330	3,730	....	....	....
Cataluchee Creek, from mouth to head	10	[a] 62	43	69	[b] 700	2,740	4,380	....	....	....
Jonathan Creek, from mouth to head	16	[a] 65	46	74	[b] 700	2,930	4,690	....	....	....
West Fork, Pigeon River, from mouth to head	14	[a] 62	50	80	[b] 400	1,820	2,910	....	....	....
Total	......	....	......	......	......	36,120	57,910	....	....	....

[a] Total area.

[b] Mean head.

The minimum indicated horsepower on other important tributaries of the French Broad is given in Table 48.

HOLSTON RIVER.

Holston River has a drainage area of 3,750 square miles, and is 142 miles long from its mouth up to the junction of North and South forks. In the lower 102 miles of the stream the fall is only 254 feet, or a little more than 2 feet per mile. In case the proposed Holston reservoir were constructed the fall would be reduced to 75 feet. The minimum indicated horsepower produced is 27,400. In the remaining 40 miles from Rogersville Station to the mouth of North and South forks there is a fall of 106 feet, and the minimum indicated horsepower here is 9,720, or 14,600 for the 6 highest months.

SOUTH FORK, HOLSTON RIVER.

South Fork is far more important a tributary than the North Fork, and has a total drainage area of 2,040 square miles. The indicated horsepower along several sections of this stream is set forth in Table 49.

TABLE 48.—*Indicated horsepower developed on other important tributaries of French Broad River.*

Section of river.	Length.	Total drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
	Miles.	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
Spring Creek, from mouth to head..	16	72	43	69	[a] 730	2,850	4,560	....	....	....
Laurel Creek, from mouth to head..	23	134	80	128	[a] 760	5,530	8,850	....	....	....
Ivy River, from mouth to Bull Creek...........	2	[b] 160	112	179	90	918	1,470	....	....	....
Ivy River, from Bull Creek to West Fork......	2	[b] 110	77	123	180	1,260	2,020	....	....	....
Turkey Creek, from mouth to head..	15	79	55	88	[a] 350	1,750	2,800	....	....	....
Swannanoa River, from mouth to North Fork.....	18	[b] 90	63	100	207	1,190	1,900	....	....	....
Hominy Creek, from mouth to head............	19	100	70	112	[a] 210	1,340	2,140	....	....	....
Mills River, from mouth to North Fork, South Fork...........	5	[b] 71	88	141	90	720	1,150	....	....	....
North Fork, Mills River, from mouth to head..	8	24	29	46	[a] 270	712	1,140	....	....	....
South Fork, Mills River, from mouth to head..	......	43	60	96	[a] 570	3,110	4,980	....	....	....
Little River, from mouth to head..	17	60	72	115	[a] 400	2,620	4,190	....	....	....
Davidsons River, from mouth to head............	13	42	59	94	[a] 550	2,950	4,720	....	....	....
West Fork, from mouth to head..	10	30	42	67	[a] 350	1,340	2,140	....	....	....
Total.......	......	....	....	....	......	26,290	42,060	....	....	....

[a] Mean head.

[b] Mean drainage area.

TABLE 49.—*Indicated horsepower developed by South Fork of Holston River.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
South Fork, Holston River:										
	Miles	*Sq. miles.*	*Sec. ft.*	*Sec. ft.*	*Feet.*					
From mouth to Watauga River	18	1,940	776	1,160	90	6,340	9,540	....	....	....
From Watauga River to Middle Fork.......	44	780	273	410	450	11,200	16,700	....	....	....
From Middle Fork to White Top Creek.....	4	350	122	183	90	999	1,490	....	....	....
From White Top Creek to head..	32	[a] 165	58	87	[b] 350	1,850	2,780	....	....	....
Total.......	......	....	....	....	......	20,389	30,510	....	....	....

[a] Total area.

[b] Mean head.

Tributaries of South Fork.—Watauga River has a drainage area of 841 square miles. The indicated horsepower along this river is set forth in Table 50.

TABLE 50.—*Indicated horsepower developed by Watauga River and tributaries.*

Section of river.	Length.	Mean drainage area.	Minimum discharge.	Minimum discharge during 6 high-water months.	90 per cent total fall.	Minimum horsepower.	Minimum horsepower during 6 high-water months.	Horsepower available from storage during a period of—		
								12 months.	6 months.	3 months.
Watauga River:										
From mouth to Doe River	*Miles.* 20	*Sq. miles.* 760	*Sec. ft.* 418	*Sec. ft.* 627	*Feet.* 180	6,840	10,300	....	....	....
From Doe River to Roan Creek.	18	484	266	399	284	6,860	10,300	....	....	....
From Elk Creek to Cove Creek	18	135	74	111	702	4,720	7,090	....	....	....
Doe River:										
From mouth to Laurel Creek	6	127	64	96	225	1,300	1,960	....	....	....
From Tiger Creek to head	14	[a] 65	32	48	[b] 670	1,950	2,920	....	....	....
Laurel Creek, from mouth to head	12	[a] 28	14	21	[b] 850	1,080	1,620	....	....	....
Stony Creek, from mouth to head	14	[a] 54	32	48	[b] 430	1,250	1,880	....	....	....
Roan River, from mouth to Doe Creek	5	160	96	144	90	783	1,170	....	....	....
Roan River, from Doe Creek to head	19	[a] 109	65	98	[b] 380	2,250	3,375	....	....	....
Elk Creek, from mouth to head	24	[a] 80	48	72	[b] 770	3,360	5,040	....	....	....
Total	......	....	....	....	......	30,393	45,655	....	....	....

[a] Total area.

[b] Mean head.

Middle Fork is a tributary of the South Fork, having a drainage area of 231 square miles. Along the lower 19 miles of its course the fall is 150 feet and the minimum discharge 95 cubic feet per second, producing a minimum indicated horsepower of 1,170, and a minimum for the 6 highest months of 1,760.

White Top Creek, a tributary of South Fork, has a drainage area of 178 square miles. The fall in the lower 5 miles is 300 feet and the minimum discharge 72 cubic feet per second. There is produced a minimum indicated horsepower of 1,760, and for the 6 highest months 2,650.

NORTH FORK, HOLSTON RIVER.

North Fork has a drainage area of only 732 square miles, and its total length is 100 miles. In the first 70 miles of the river there is a fall of 500 feet, which will produce a minimum indicated horsepower of 6,460. The remaining 30 miles to the head of the river has a total fall of 800 feet, of which 230 may be considered as a reasonable working head. The minimum discharge is 55 cubic feet per second, which will produce a minimum of 1,150 horsepower. Big Moccasin Creek, a tributary of North Fork, 34 miles long, has a total drainage area of 93 square miles. It has a mean head of 570 feet. The minimum indicated horsepower produced by this stream throughout the entire stretch is 1,710.

CONCLUSION.

The facts given in previous pages require no further elucidation. Great as they show the water-power facilities to be, they do not convey an adequate idea of the immense possibilities of the region.

Approved:
JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *January 15, 1908.*

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